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Applicant EISINGER, Lee

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(71)(72) Applicant and Inventor: EISINGER, Lee [US/US]; 463 Locust Street, Akron, OH 44307 (US). (74) Agent: SKERIOTIS, John, M.; 4421 Ranchwood Spur, Akron, OH 44333-1343 (US).		Published <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>	
<p>(54) Title: APPLICATION OF TEXTURED OR PATTERNED SURFACES TO A PROTOTYPE</p> <p>(57) Abstract</p> <p>Rapid prototyping technologies are being used to save time and money. One such method of producing a rapid prototype is that known as stereolithography. This method creates a tangible 3-D object from a CAD drawing by directing ultraviolet laser radiation onto a vat of polymer resin. The invention disclosed pertains to application of a texture or pattern to a prototype part produced from such method above. The texture or pattern is applied to the surface of the prototype part. The method involves using a photo-sensitive resist that is sprayed onto the surface of the item until a predetermined thickness is achieved. Portions of the surface are pre-selected to provide a texture or pattern. Other portions of the surface are masked or otherwise protected from exposure to a radiation source. After exposure to a light source, the unhardened photo resist is removed, leaving the exposed photo resist on the surface forming the pre-selected pattern or texture.</p>			
<p style="text-align: center;">APPLICATION OF TEXTURED OR PATTERNED SURFACES</p> <pre> graph TD A[Provide Object -> may be formed from SLA process] --> B[Clean Surface] B --> C[Apply Photo Resist -> predetermined thickness] C --> D[Dry Resist] D --> E[Transfer Pattern and Mask to Prevent Exposure to predetermined areas] E --> F[Expose Resist to Curing Source] F --> G[Removal of Unexposed Resist] G --> H[Inspect Pattern] H --> I[Optional -> Apply Color] </pre>			

APPLICATION OF TEXTURED OR PATTERNED SURFACES TO A PROTOTYPE

Background of the Invention5 1. Field of Invention

This invention pertains to the art of rapid prototyping technological methods and apparatuses for producing an end product that is an exact model of a 3-dimensional drawing, and more specifically, to methods and apparatuses for applying a texture or pattern to the surface of a prototype part.

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2. Description of the Related Art

The need for rapid prototyping is known in the art in order to reduce design iterations, production, and tooling costs. One process used to quickly produce prototype parts is called stereolithography, or SLA. While there are various manufacturers of the equipment used to produce the same type of product, the resulting item is generally referred to as a SLA part or model. The term prototype parts refers to a part to be used for display or sample purposes. The process used to manufacture this prototype part is not germane to this application.

20 Stereolithography is a 3-dimensional printing process that produces a solid plastic model. The process involves automating a laser to draw or print cross sections of the model onto the surface of photo-curable liquid plastic.

25 Stereolithography creates a tangible 3-dimensional object from a computer aided drawing (CAD) by directing ultraviolet laser radiation onto a vat of polymer resin, liquid plastic. Using a stereolithography apparatus (SLA), the CAD model data is sliced by proprietary software into to very thin cross sections. The laser generates a small intense spot of ultraviolet (UV) light, which is moved across the top of a vat of liquid photopolymer into a solid where it touches, precisely printing each cross-section. A vertical elevator system lowers the newly formed layer while a leveling system establishes the thickness of the next layer.

30 Successive cross-sections, each of which adheres to the one below it, are built one layer on top of another to form the part from the bottom up. After the last layer is made, the part is removed from the SLA and flooded with high intensity UV light to complete the polymerization process. In the art, the surface of the part is then

In accordance with one aspect of the invention, a method for providing a raised feature on a surface of a prototype model is provided. The method is characterized by the steps of:

- (a) providing a model having at least one surface on which to provide a raised feature;
- 5 (b) coating the surface with a photo resist to a predetermined thickness;
- (c) providing means for preventing exposure of a first portion of the photo resist to a radiation source while allowing exposure of a second portion of the photo resist wherein the second portion of the photo resist provides the raised feature;
- 10 (d) exposing the surface to a radiation source to chemically alter the second portions of the photo resist; and,
- (e) removing the first portion of the photo resist from the surface while leaving the raised feature formed by the exposed photo resist on the surface.

According to another aspect of the invention, the step of coating the surface with a photo resist is further characterized by the steps of applying the photo resist in more than one layer.

According to another aspect of the invention, when the photo resist is applied in more than one layer, sufficient drying time between successive layers of the photo resist is required.

20 According to another aspect of the invention, the surface of the prototype model is cleaned before the step of coating the surface with the photo resist.

According to another aspect of the invention, the method further includes the steps of:

25 inspecting the raised feature after the step of removing the first portion of the photo resist; and,

repeating steps (b) - (e) to enhance the raised feature.

According to another aspect of the invention, the step of providing a model is characterized by providing a model formed by a stereolithography process.

30 According to another aspect of the invention, a prototype model is provided which has a raised feature on at least one surface wherein the raised feature is formed by the inventive method.

One advantage of the present invention is that the end product is an exact model of the 3-D drawing giving designers, engineers, manufacturers, sales

Figure 1 shows a book bag 10 having a textured surface 12. The cloth pattern 14 on this textured surface 12 can be made on a prototype part by use of the present invention. Figure 2 shows the sole of an athletic shoe 18. The logo 20 on the sole of this athletic shoe 18 may be produced by the current invention. Figure 3 shows a golf ball 26 showing the multitude of dimples 28 within the surface of the golf ball 26. These dimples 28 may be shown on a prototype model by using the method of the present invention. Figure 4 shows a softball 30 showing a thread pattern 32. Again, a pattern such as this may be shown on a prototype model. Figure 5 shows a planter basket 36 made from woven material. A replicate surface could be shown on a prototype model. Figure 6 shows a tread pattern 40. The texture and pattern of this surface is likewise able to be produced by the current invention.

Figure 7 shows a ceramic pot 44 having an ornamental design 46 on its exterior. The ornamental design 46 could be produced on the surface of a prototype model by the current invention. Figure 8 shows an alternative plastic pot 50. The exterior surface 52 of this pot 50 has a rough surface design on it. The current invention may also be used to produce this surface design.

Figure 9 shows a piece of glassware 56 having various designs 58. In making an actual product, the designs 58 would be typically cut or pressed into the glassware 56. By using the present invention, designs could be considered and altered very quickly.

Figure 10 shows a cloth handbag 60 having a fanciful textured design 62 on it which may be produced on a prototype model by the current invention. Finally, Figure 11 shows a paperweight 64. Again, the design for the paperweight may be first produced on a prototype and modified if necessary by using the present invention before incurring the expense and time of actually producing the product.

Figure 12 is directed to a flow chart showing the steps in the inventive process. The method generally includes the following steps. Firstly, a model is provided which has at least one surface on which a textured surface is desired. In the preferred embodiment, the model is formed by the known processes referred to herein as SLA. The desired surface is then coated with a photo resist to a predetermined thickness. The thickness will correspond to the desired height of any raised features formed on the surface. A pre-selected pattern is transferred to the surface and some portions are masked by coating with wax or film, or other means are provided for

What is claimed:

1. A method for providing a raised feature on a surface of a prototype model characterized by the steps of:
 - 5 (a) providing a model having at least one surface on which to provide a raised feature;
 - (b) coating the surface with a photo resist to a predetermined thickness;
 - (c) providing means for preventing exposure of a first portion of the photo resist to a radiation source while allowing exposure of a second portion of the photo resist wherein the second portion of the photo resist provides the raised feature;
 - 10 (d) exposing the surface to a radiation source to chemically alter the second portions of the photo resist; and,
 - (e) removing the first portion of the photo resist from the surface while leaving the raised feature formed by the exposed photo resist on the surface.
- 15 2. The method of claim 1 wherein the step of coating the surface with a photo resist is further characterized by the steps of applying the photo resist in more than one layer.
- 20 3. The method of claim 2 further characterized by the step of:
 - allowing sufficient drying time between successive layers of the photo resist.
4. The method of claim 1 further characterized by the step of:
 - 25 cleaning the surface of the prototype model before the step of coating the surface with the photo resist.
5. The method of claim 1 further characterized by the steps of:
 - 30 inspecting the raised feature after the step of removing the first portion of the photo resist; and,
 - repeating steps (b) - (e) to enhance the raised feature.

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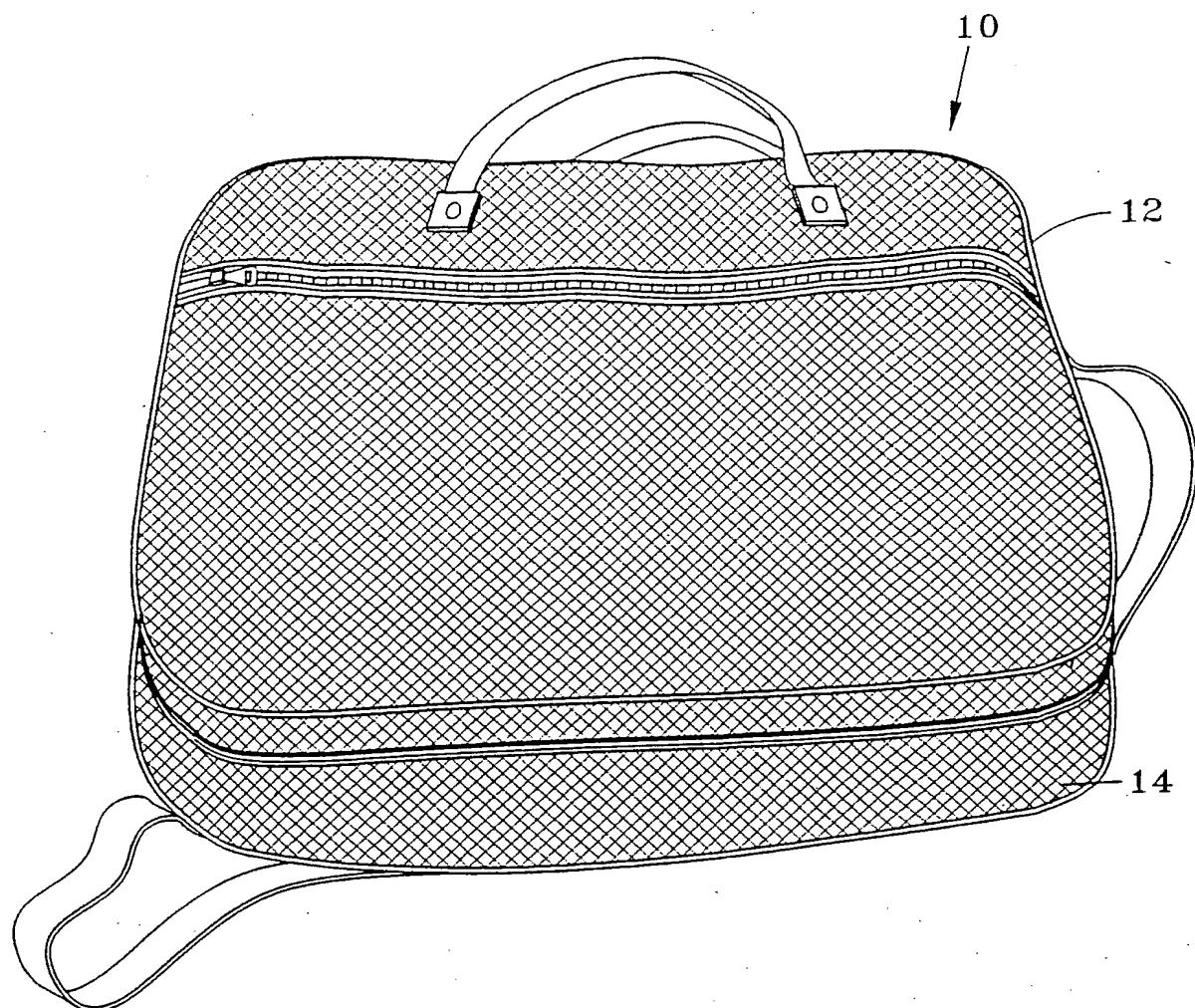


FIG-1

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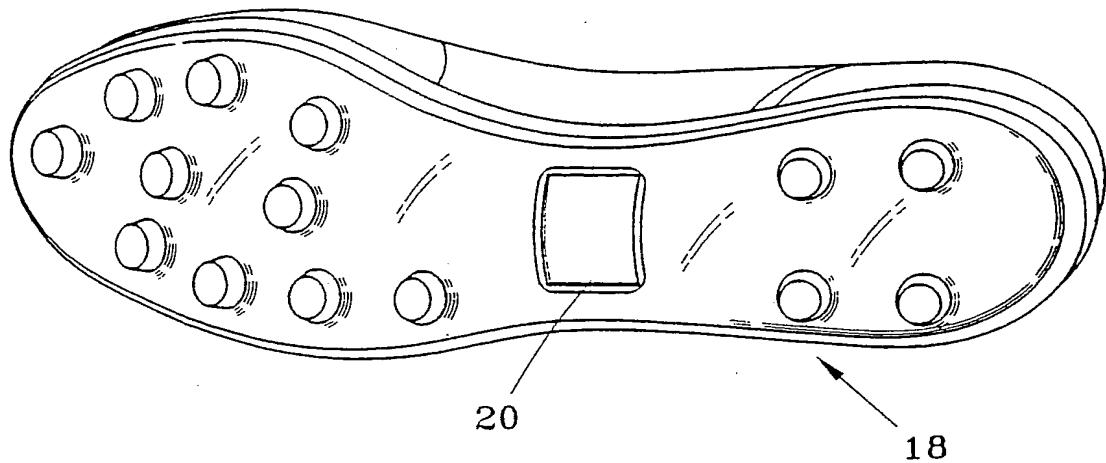


FIG-2

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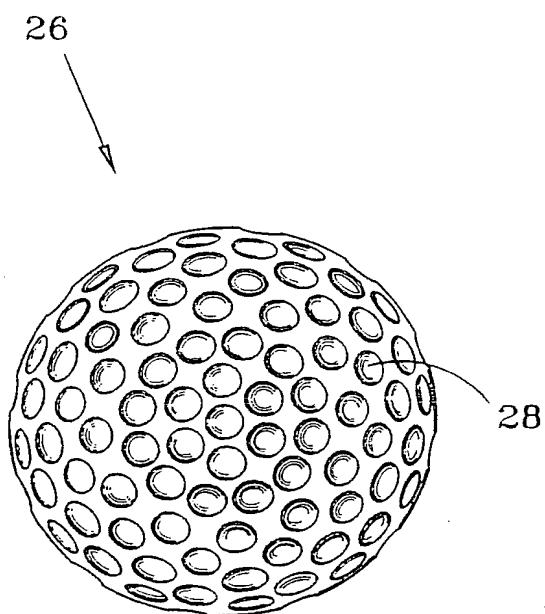


FIG-3

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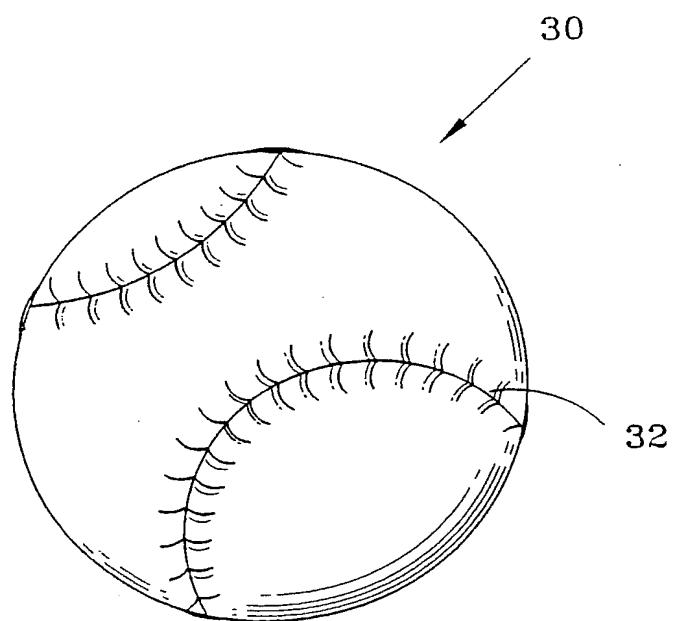


FIG-4

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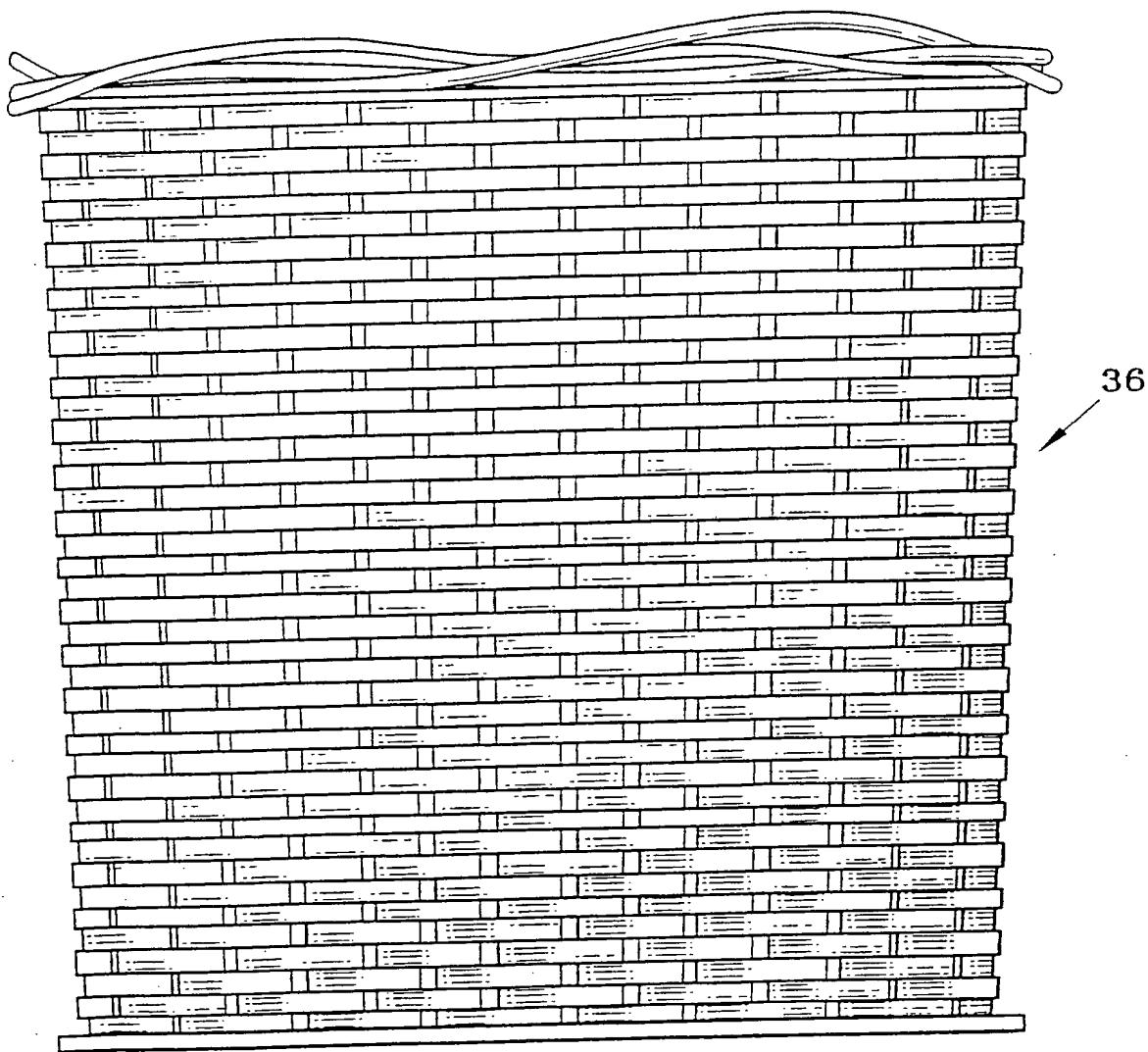


FIG-5

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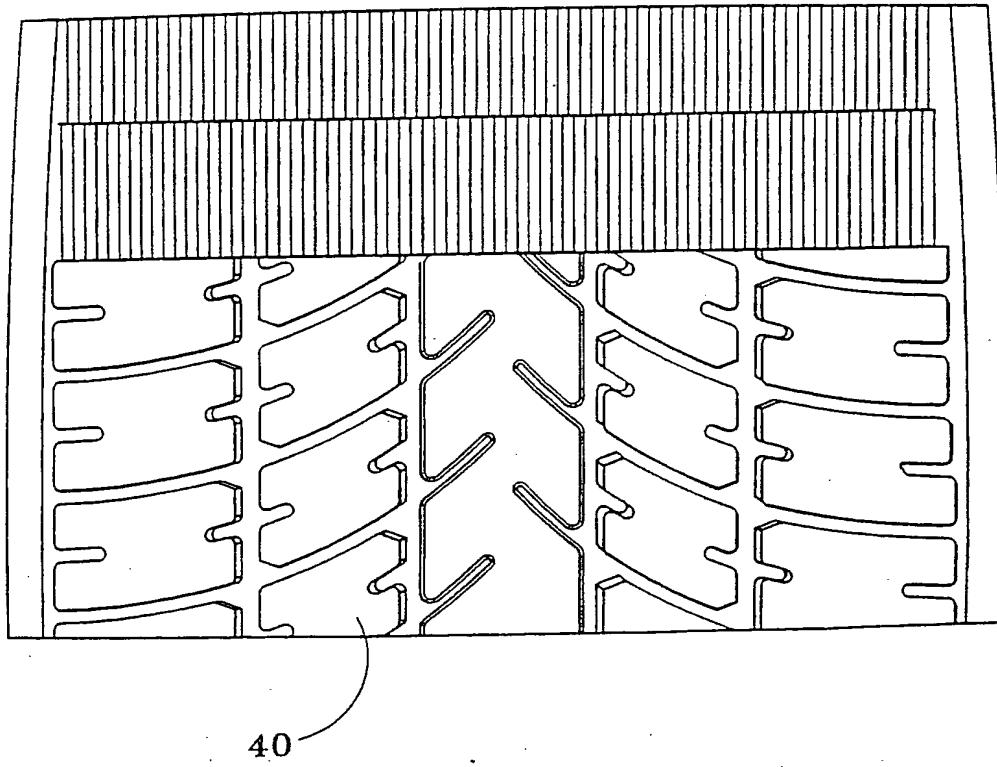


FIG-6

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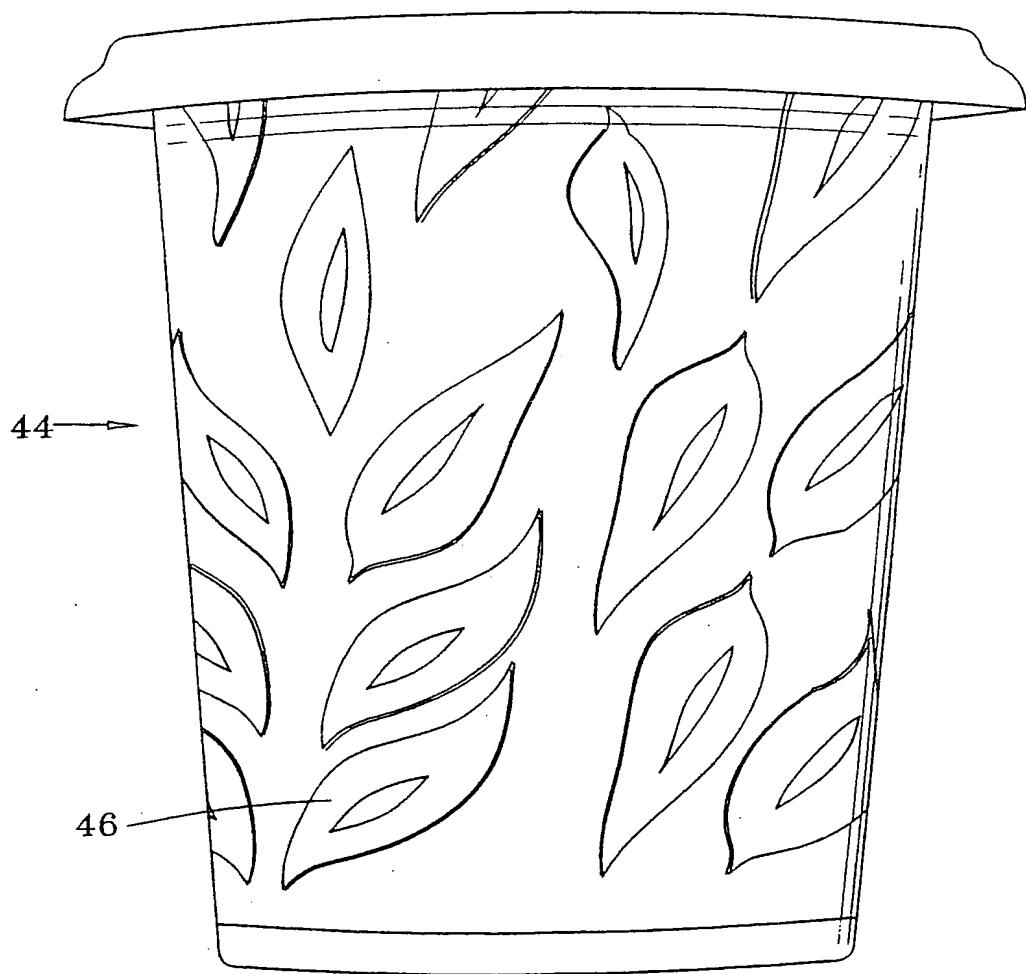


FIG-7

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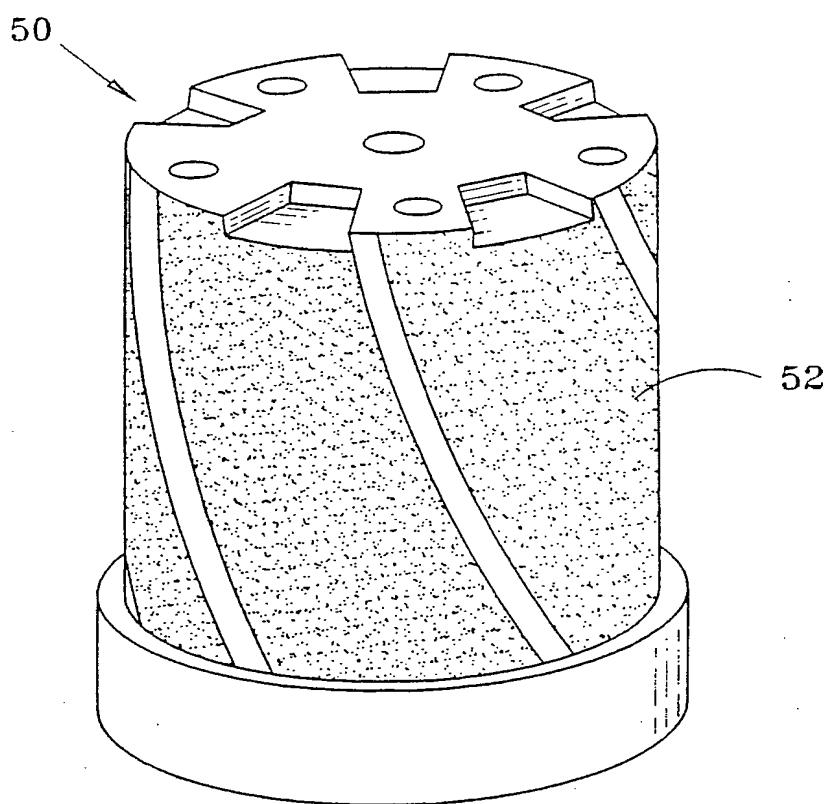


FIG-8

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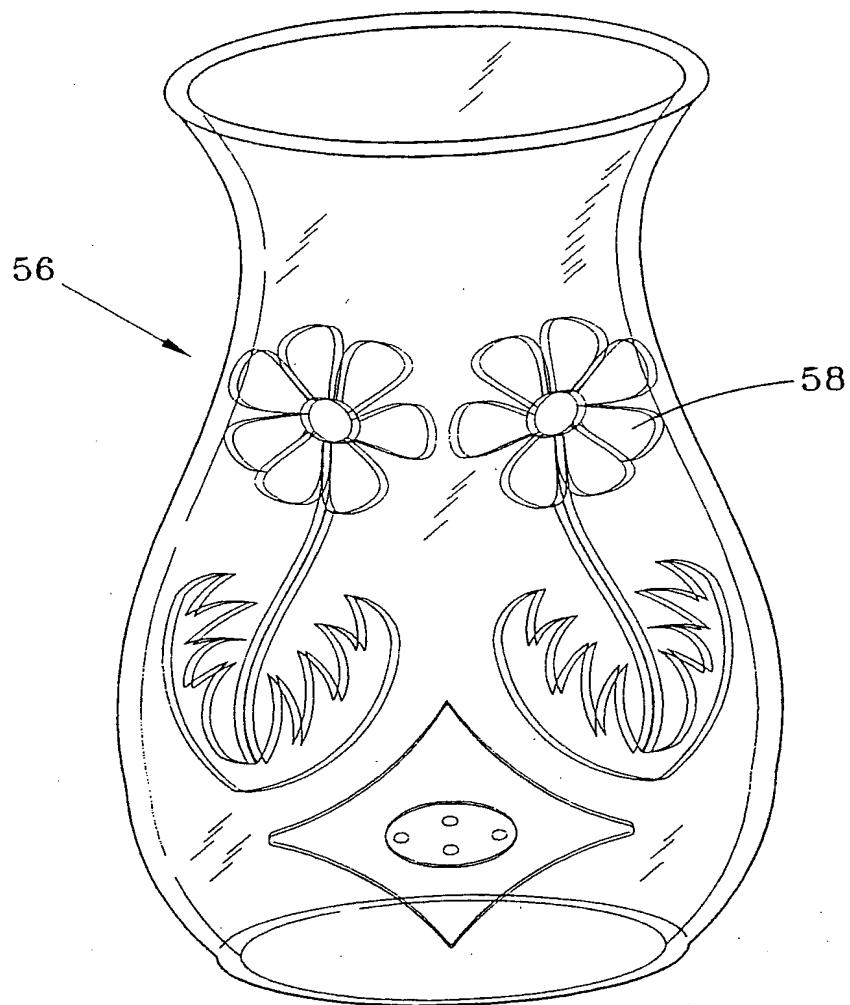


FIG-9

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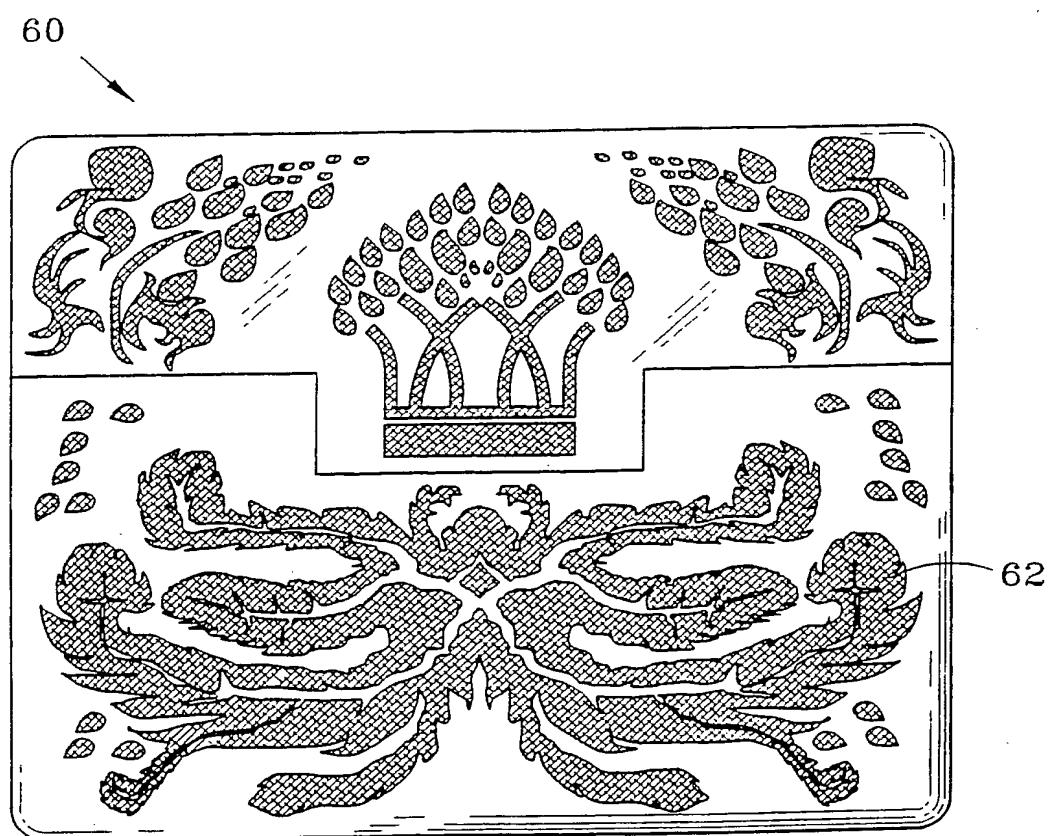


FIG-10

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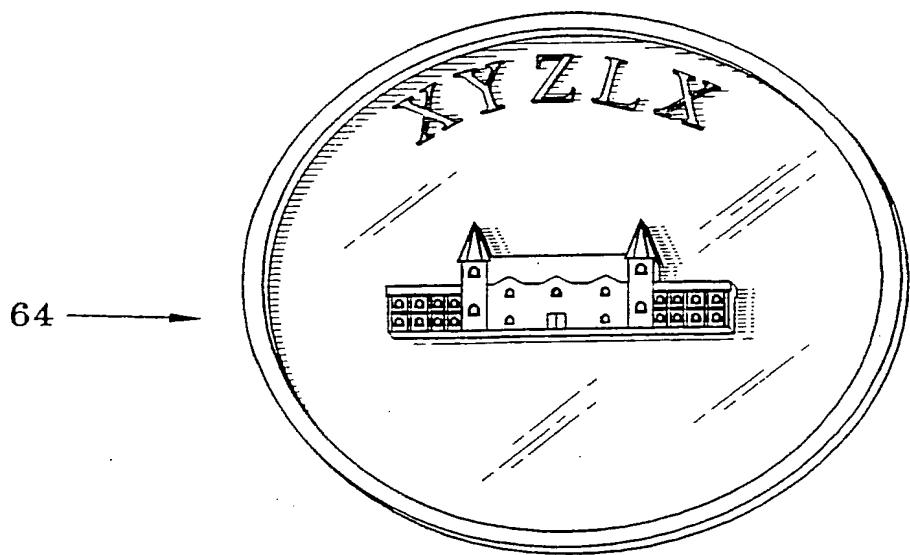


FIG-11

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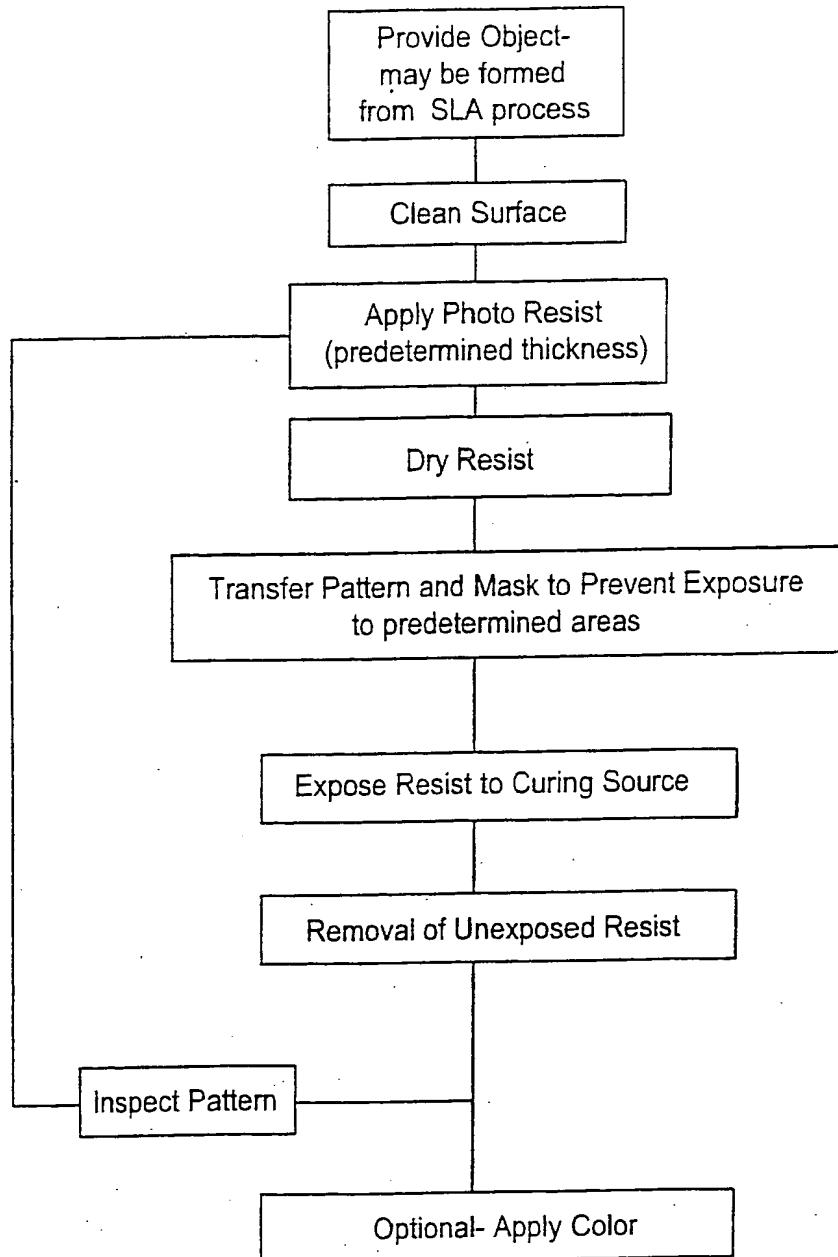
APPLICATION OF TEXTURED
OR PATTERNED SURFACES

FIG-12

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 00/06205

A. CLASSIFICATION OF SUBJECT MATTER
 IPC 7 B29C67/00 B29C37/00 G03F7/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
 IPC 7 B29C G03F G03C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 442 071 A (DU PONT DEUTSCHLAND) 21 August 1991 (1991-08-21) the whole document ---	1-7
X	GB 2 035 602 A (POLLAK J) 18 June 1980 (1980-06-18) the whole document ---	1-7
X	PATENT ABSTRACTS OF JAPAN vol. 009, no. 331 (C-321), 25 December 1985 (1985-12-25) -& JP 60 161772 A (TOYOTA JIDOSHA KK), 23 August 1985 (1985-08-23) abstract; figures ---	1-5, 7
X	WO 98 33761 A (CIBA GEIGY AG) 6 August 1998 (1998-08-06) page 30 -page 32; claims 12-16 ---	1, 6, 7
		-/-

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

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Date of the actual completion of the international search

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Date of mailing of the international search report

19/07/2000

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

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